

REMARKS

As noted previously, the Applicants appreciate the Examiner's thorough examination of the subject application.

Claims 1-11 and 21-30 are pending in the application and were rejected in the non-final Office Action mailed 25 March 2007 on various statutory grounds, described in further detail below. Claims 1 and 21 are amended herein. No new matter has been added.

Applicants request reconsideration and further examination of the subject application in light of the foregoing amendments and the following remarks.

Summary of Examiner Interview under 37 CFR § 1.133

The following is a summary, pursuant to 37 CFR § 1.133, of a telephonic interview conducted on 22 April 2008 between Examiner Zervigon, inventor, William Randy Clark, and Applicants' attorney, G. Matthew McCloskey, regarding the subject application and co-pending divisional application U.S. Application No. 11/588,042. As a preliminary matter, Mr. Clark and Applicants' attorney both thank Examiner Zervigon for holding the in-person interview.

During the referenced interview, claim 1 of the subject application were discussed. The prior art discussed was U.S. Patent No. 5,565,038 to Ashley ("Ashley") and U.S. Patent Application Publication No. 2004/0244837 to Nawata et al. ("Nawata"). Agreement was not reached with respect to the claims.

As part of the referenced interview, Mr. Clark explained how the claimed invention was developed and the differences relative to the noted references. Concerning Ashley, it was noted that the controller of Ashley makes no calculations as to quantities of delivered mass. Rather, the system and controller of Ashley employ a down stream chemical detector (selected to detect byproduct chemicals resulting from the interaction of interhalogen gasses and semiconductor processing films) to send a signal to the Ashley controller, which shuts off the related mass flow controller ("MFC")

when the signal from the chemical detector drops below a predetermined level.

Mr. Clark also explained that Nawata teaches away from any measurements of pressure for short time periods, e.g., less than a second, as Nawata teaches essentially that transient effects during short time periods render such measurements useless. Mr. Clark cited the specific paragraphs [0098]-[0099] of Nawata in support of this contention.

Mr. Clark and Applicants' attorney also stressed that a key difference of the claims over the cited art was that for the claimed systems, the calculation of the amount of mass being delivered was performed while the outlet valve is in an open condition.

In response to Mr. Clark's explanation of the teachings of Nawata, the Examiner suggested that the listing of claims be amended to include recitation of a time frame for the duration of opening of the outlet valve to facilitate distinguishing the claims over the prior art. On this point, and to further clarify the claimed invention, claims 1 and 21 have been amended to include recitation of a representative time range for the length of time that the system outlet valve is open. Mr. Clark and Applicants' attorney also stressed that a key difference of the claims over the cited art was that for the claimed systems, the calculation of the amount of mass being delivered was performed while the outlet valve is in an open condition.

Claim Rejections – 35 U.S.C. § 103

Claims 1-8, and 21-26

Concerning items 2-3 of the Office Action, claims 1-8, and 21-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,565,038 to Ashley ("Ashley") in view of U.S. Patent Publication No. U.S. 2004/0244837 to Nawata et al. ("Nawata"). Applicants respectfully traverse the rejection and request reconsideration for the following reasons and in light of the following synopses of the cited art.

(a) Claimed Systems

Claim 1 (representative of the independent claims under rejection) as amended recites the

following:

1. A system for delivering a desired mass of gas, comprising:
 - a chamber;
 - a first valve controlling gas flow into the chamber;
 - a second valve controlling gas flow out of the chamber;
 - a pressure transducer providing measurements of pressure within the chamber;
 - a controller connected to the valves and the pressure transducer, wherein the controller is configured and arranged to
 - (i) receive a desired mass flow setpoint from an input device;
 - (ii) close the second valve;
 - (iii) open the first valve;
 - (iv) receive chamber pressure measurements from the pressure transducer;
 - (v) close the first valve when pressure within the chamber reaches a predetermined level;
 - (vi) wait a predetermined waiting period to allow the gas inside the chamber to approach a state of equilibrium;
 - (vii) open the second valve at time = t_0 ;
 - (viii) calculate a value of the total mass delivered as the second valve is open and as a function of temperature and pressure within the chamber; and
 - (ix) close the second valve at time = t^* when the calculated value of total mass delivered equals the desired mass flow setpoint, wherein t^* is from about 100 milliseconds to about 500 milliseconds.

[Emphasis added]

The system of amended claim 1 includes a first (inlet) and a second (outlet) valve and a pressure transducer/sensor that are connected to a chamber and to a controller. The controller is configured and arranged to control the operation of the valves so that a precise mass of a gas can be delivered through the second valve. Of particular note, Applicant's controller continuously monitors pressure and temperature of the gas within the chamber, and calculates the actual mass delivered by Applicant's system while the outlet valve is open and delivering gas, thereafter closing the outlet valve at the precise time that a mass flow set point is calculated as having been reached, wherein the time is from about 100 milliseconds to about 500 milliseconds

(b) Ashley – U.S. Pat. No. 5,565,038

The Examiner relies on Ashley as the primary reference for the rejection. Ashley teaches systems and methods for removing accumulated films from processing equipment by utilizing the continuous flow of an interhalogen gas acting as an etchant through a chamber. The flow, once turned on, is controlled by a thermal mass flow controller of the type discussed in “Applicant’s Background of the Disclosure” of the subject application. See, e.g., paragraph [0004]. While the Examiner asserts again that Ashley teaches that its MFC calculates actual mass delivered by the system, Applicant respectfully submits that this is not the case for the Ashley reference. The MFC taught by Ashley is utilized for supplying the interhalogen etchant gas(es) to the gas manifold and chamber of Ashley.

Ashley in fact does not teach that its controller calculates actual mass flow emitted from the system. Ashley teaches only that the valve is shut off when a down stream concentration detector detects a specified amount of reaction byproduct:

Detector 12 is set to sense a product gas, which for a polysilicon deposition system is a silicon-halide gas, and sends a signal to the computer 20 which varies with the concentration of the product gas present at the detector 12. The signal starts at one value prior to detecting any silicon halide, changes as the amount of silicon halide increases, and then returns to the initial level once all of the accumulated material has reacted since no more silicon halide is produced. Once the detector 12 signal reaches a predetermined level, the computer 20 determines that little, if any, accumulated film is still present in chamber 7. Computer 20 starts a timer (not shown) to give the desired overetch using a predetermined time. The cleaning portion of the process is completed once the time expires.

(Ashley, col. 9, lines 24-37.)

[Emphasis added]

Consequently, the system of Ashley is structurally and functionally different than the Applicant’s claimed systems and methods.

(c) Nawata – U.S. Pat. Pub. No. U.S. 2004/0244837

Nawata is cited as the secondary reference for the rejection. Nawata teaches a pulse shot regulator and pulse shot regulating method. The system and method of Nawata utilize an inlet valve,

a volume, an outlet valve, pressure measurement, temperature measurement, and an overall controller. As the Examiner noted, Nawata also teaches use of equations of state to determine flow from a known volume.

The system and method of Nawata, however, measure the volume flow Q of gas exhausted from a cutoff valve based on a difference in pressures within a delivery chamber after the inlet valve is closed, and again after the outlet valve is closed, i.e., at the beginning and end of the delivery process. See Nawata, paragraph [0060].

For the Nawata system and method, measurements are made only after a particular gas flow delivery process (or pulse shot) has been completed. See Nawata, paragraph [0061]. See, also, Nawata, Abstract:

A flow controller and a flow controlling method are adapted to be released from conventional restrictions by using a novel type called a pulse shot type. A pulse shot (opening/closing operation of a first cut off valve (12) and, after that, opening/closing operation of a second cutoff valve ((17)) is repeated.

[Emphasis added]

Importantly, if the mass in the gas flow delivered by the Nawata system is insufficient for required purposes, the only recourse is to correct the error by a subsequent delivery process (pulse shot) as the Nawata system does not measure actual mass delivered by the system when the outlet valve is in an open condition. Moreover, Nawata in fact teaches that when “the filling/exhaust cycle becomes shorter,” which Nawata references as a period of less than one second, “it is useless to measure the pressure during the period.” Nawata, paragraphs [0097]-[0098].

Additionally, on this point, Nawata even more resolutely teaches that in “the case of making pulse shots at high frequency, however, high-precision flow management cannot be performed.” Nawata, paragraph [0099].

Thus, the systems and methods of Nawata are not structurally or functionally equivalent to

Applicant's claimed systems and methods.

(d) Prima Facie Case of Obviousness not established

For a rejection under the 35 U.S.C. § 103(a), the cited reference(s) must teach or suggest each and every of the limitation in the claim(s) at issue. A further requirement for a rejection under 35 U.S.C. § 103(a) is that proper motivation must exist to modify the cited reference(s) in the proposed manner. In this situation, the combination of Ashley and Nawata fails to teach or suggest each and every limitation in claims 1-8, and 21-26 as amended; further, there is no motivation to modify the teachings of the references in the way proposed by the Examiner. Thus, a *prima facie* case of obviousness for a rejection under 35 U.S.C. § 103(a) has not been established.

For the rejection, the Examiner characterized Ashley as teaching, inter alia:

a controller (20; Figure 1; column 8, lines 17-67) connected to the valves and the pressure transducer ("PS8"; Figure 1; column 8, lines 17-27) wherein the controller (20; Figure 1; column 8, lines 17-67) is configured and arranged to, receive a desired mass flow setpoint (column 9; lines 1-20) from an input device (20; Figure 1; column 8, lines 17-67 = compare to applicant's specification [0031]), close the second valve (13/14; Figure 1; column 8, lines 1-16); open the first valve (4; Figure 1; column 8, lines 1-16); receive chamber (7; Figure 1; column 8, lines 17-27) pressure measurements from the pressure transducer ("PS8"; Figure 1; column 8, lines 17-27); close the first valve (4; Figure 1; column 8, lines 1-16) when pressure within the chamber (7; Figure 1; column 8, lines 17-27) reaches a predetermined level; wait a predetermined waiting period to allow the gas (1; Figure) inside the chamber (7; Figure 1; column 8, lines 17-27) to approach a state of equilibrium; open the second valve (13/14; Figure 1; column 8, lines 1-16) at time = t_0 ; calculate a value of the total mass delivered as the second valve (13/14; Figure 1; column 8, lines 1-16) is open and as a function of temperature and pressure within the chamber; and close the second valve (13/14; Figure 1; column 8, lines 1-16) at time = t^* when the calculated value of total mass delivered equals the desired mass flow setpoint (column 9; lines 1-20) – claim 1.

[Emphasis added]

Applicants respectfully traverse this characterization of Ashley as there is no description or suggestion in Ashley of all of the limitations as arranged in amended claims 1 and 21 of the subject application.

The portion of Ashley cited by the Examiner (as allegedly teaching a setpoint and closing the second valve at time = t^* when the calculated value of total mass delivered equals the desired mass flow setpoint) is not understood as supporting what the Examiner contends.

To the contrary, the computer taught by Ashley begins an overetch timer and then begins a ramp down process to reduce flow rate from a mass flow controller only after the concentration detector (12) has sent a signal corresponding to a predetermined level of product gas downstream of the chamber. See Ashley, Fig. 1 and col. 9, lines 32-40. The closing of the MFC of Ashley is based on signals received from the detector, which is set to detect byproduct gas. Ashley fails to teach or suggest a calculation of actual mass flowing through the system based on a pressure signal from a pressure sensor and a temperature value, in stark distinction with Applicants' claims.

Thus, Ashley does not teach (or suggest) a system that calculates mass being delivered from the system and closing an output (or second) valve of the system based on the calculated amount of mass delivered by the system, in distinction with the independent claims in the subject application, claims 1 and 21. These deficiencies of Ashley are not remedied by the secondary reference, Nawata, as is explained below.

As described previously, Nawata teaches measurements are made only after a particular gas flow delivery process (or pulse shot) has been completed. See, e.g., Nawata, paragraph [0061].

Furthermore, while Nawata does teach use of equations of state, e.g., in paragraphs [0102]-[0111], these equations are based on pressure and temperature measurements "in a sealed state after filling/exhaust in the gas filling capacity 13". Nawata, paragraph [0102]. Nawata plainly teaches that these equations utilize pressure and temperature measurements of the gas filling capacity (chamber 13) after it is filled and then after its exhaust. Importantly, Nawata teaches that the exhaust

of the gas filling capacity is completed when the second (outlet) cutoff valve, and only then (at time t_0) can calculations of a time constant of pressure change be performed, with these time constants subsequently being used to calculate volumetric flow. See, e.g., paragraph [0127] with regard to FIG. 10.

The Applicants' claimed systems operate in a fundamentally different manner than the system of Nawata by calculating and thereby measuring the mass of gas as it is delivered from the chamber through the outlet valve in an open state. Such an open state could correspond to the portion of the pressure curve of Nawata's FIG. 10, between the opening of the second cut-off valve and the closing of the cutoff valve at time = t_0 . Nawata teaches that its systems and techniques are incapable of accurately calculating mass flow in such a region.

The Applicants' systems consequently provide advantages over prior art techniques, such as Nawata, by automatically compensate for varying charge pressures, downstream pressures (which affect flow out of the delivery chamber), and orifice geometries and timing characteristics of the inlet and outlet valves, while still delivering a desired quantity of gaseous mass.

Not only does the combination of Ashley and Nawata not teach or suggest all of the elements of independent claims 1 and 21, as described above, but proper motivation does not exist to modify the references in the way suggested by the Examiner. In making the rejection, the Examiner stated that one of skill in the art would find it obvious to optimize the operation of Ashley's as taught by Nawata. Applicants traverse this statement and respectfully submit that the Examiner may have employed hindsight analysis, to an impermissible extent, for the rejection. Moreover, one skilled in the art would appreciate both Ashley and Nawata as teaching away from claims 1 and 21 (from which the remaining claims under rejection depend).

As noted previously, the operation of the systems and methods of Ashley are based on a mass flow controller permitting flow of an interhalogen gas through the system to etch away films accumulated during normal operation of the system. A central point of Ashley is that the Ashley MFC continues to supply the etchant interhalogen gas to the system until the targeted accumulated

films have been cleaned (etched) from the system. The way this is accomplished, Ashley teaches, is by the use of a gas detector. The gas detector is placed downstream of the gas manifold and chamber, i.e., outside of the regular processing equipment.

In doing so, Ashley teaches that the mass flow controller is (i) kept open long enough for the interhalogen gas(es) to remove the targeted films, and (ii) caused to close automatically, upon receiving a signal from a downstream concentration sensor. Thus, Ashley does not teach using pressure and temperature measurements to calculate a desired mass and closing an output/second valve at a calculated time. Because of this shortcoming actually teaches away from the limitations as recited in independent claims 1 and 21 of the subject application.

The Nawata reference also teaches away from the systems of claims 1 and 21 by teaching that all mass calculations for mass delivery by “pulse shots” are performed only after the second cutoff valve has closed and after the mass from the “gas filling capacity” has exited (been exhausted from) the Nawata system.

As was stated previously, Nawata plainly teaches away from Applicants’ claims (and the Examiner’s proposed modification) by teaching the following:

When the filling/exhaust cycle becomes shorter, the heat exchange continues also in a sealed state after the filling/exhaust, and both temperature and pressure continue changing. **Therefore, it is useless to measure the pressure during the period. It is necessary to measure the pressure after completion of the heat exchange or after the temperature decreases to a temperature at which there is no problem with precision,** and use the measured temperature for the flow calculation.

In the case of making pulse shots at high frequency, however, high precision flow measurement cannot be performed. . . .

(Nawata, Paragraphs [0098]-[0099])[Emphasis added]

Because of the foregoing reasons, the combination of Ashley and Nawata is an improper basis for a rejection of claims 1-8, and 21-26 under 35 U.S.C. § 103(a), and the rejection of claims 1-

8, and 21-26 under 35 U.S.C. § 103(a) should be removed accordingly.

Claims 1-10, 21-26, and 30

Concerning item 4 of the Office Action, claims 1-10, 21-26, and 30 were rejected under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over Nawata, previously cited. Applicants respectfully traverse the rejection and request reconsideration for the following reasons.

For the rejection, when referring to claim 1, the Examiner contends that Nawata teaches a controller that is programmed to, among other things “open the second valve at time $t=t_0$; and close the second valve at time t^* when the mass of gas (“from process gas source”; Figure 1) discharged equals the desired mass.”

Applicants respectfully submit that this characterization of Nawata is inaccurate and that Nawata does not teach or suggest (or provide motivation for) all of the limitations of claim 1 (set forth above) and/or claim 21.

While correctly noting that “Nawata is not specific in teaching the operation of his valves with respect to the computer logic and processing claimed in claims 1-8, and 21-29,” the Examiner attempts to buttress the rejection by stating “In the event that Nawata is not deemed to anticipate Applicant’s claimed inventions, it would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the operation of the claimed apparatus.”

As was stated previously, Nawata does not teach or suggest a controller that is configured and arranged as recited in independent claims 1 and 21, and therefore does not anticipate independent claims 1 and 21 or for that matter any claims dependent upon claims 1 and 21.

Furthermore, as was stated previously, Nawata actually teaches away from the elements of claims 1 and 21 by teaching that a pulse shot is completed prior to any pressure measurements for mass calculations and that for short time periods “it is useless to measure the pressure.” See Nawata,

paragraphs [0097]-[0099].

Thus, Nawata is an improper basis for a rejection of claims 1-10, 21-26, and 30 under 35 U.S.C. § 102(e)/§103(a), and these claims are patentable over Nawata. Because of this, the rejection of claims 1-10, 21-26, and 30 under 35 U.S.C. § 102(b)/§103(a) should be withdrawn accordingly and the claims allowed.

Claims 11 and 27-29

Concerning item 5 of the Office Action, claims 11 and 27-29 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Nawata in view of U.S. Patent No. 6,193,212 to Ohmi et al. (“Ohmi”). Applicants respectfully traverse the rejection and request reconsideration for the following reasons.

The deficiencies of Nawata relative to claims 1 and 21 (from which claims 11 and 27-29 depend, respectively) are described above. For the rejection, the Examiner correctly noted that Nawata fails to teach or suggest that the second valve has a response time of about 1 to 5 milliseconds, and then cited Ohmi as allegedly remedying the deficiency of Nawata concerning the teaching of a response time of about 1 to about 5 milliseconds.

Without acceding to the accuracy or correctness of the Examiner’s characterization of the teachings of Ohmi or any ostensible motivation to combine or modify the noted references, Ohmi fails to remedy the previously described deficiencies of Nawata relative to claims 1 and 21, respectively, the base claims for claims 11 and 27-29. Thus, the rejection of claim 11, and 27-29 under 35 U.S.C. § 103(a) is without proper basis and should be withdrawn.

Response to Arguments

Concerning item 10 of the Office Action, Applicant takes issue with the Examiner’s contention that Ashley’s setpoint of 200 mT is inherently a calculated value of total mass delivered. In rebuttal, it is noted that Ashley teaches no set end time for such a pressure, and therefore no amount of mass delivered is ever actually calculated.

Concerning item 12 of the Office Action, Applicants take issue with the Examiner's statement, and, as was explained during the telephonic interview with the Examiner on 22 April 2008, the cited prior art (in combination of the knowledge of one skilled in the art) actually teaches away from the Applicants' amended claims.

Conclusion

In view of the amendments and remarks submitted herein, Applicants respectfully submit that all of the pending claims in the subject application are in condition for allowance, and respectfully request a Notice of Allowance for the application.


If a telephone conference will expedite prosecution of the application, the Examiner is invited to telephone the undersigned.

Authorization is hereby given to charge our deposit account, No. 50-1133, for any fees required for the prosecution of the subject application.

Respectfully submitted,

McDERMOTT WILL & EMERY LLP

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Toby H. Kusmer, P.C., Reg. No. 26,418
G. Matthew McCloskey, Reg. No. 47,025
Attorneys for Applicants
28 State Street
Boston, MA 02109-1775
Telephone: (617) 535-4082
Facsimile: (617) 535-3800